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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/752,798 | 12/28/2000 | Mohamed Arafa | 42390P8119 | 9364 |

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EXAMINER

MAI, ANH D

ART UNIT PAPER NUMBER

2814

DATE MAILED: 12/28/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/752,798

Applicant(s)

ARAFAT ET AL.

Examiner

Anh D. Mai

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 December 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5 and 7-19 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5 and 7-19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on December 9, 2004 has been entered.

Status of the Claims

2. Amendment filed December 9, 2004 has been entered. Claims 1 and 11 have been amended. Claims 1-5 and 7-19 are pending.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-5, 7-14, 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chern et al. (U.S. Patent No. 6,150,223) in view of Laxman et al. (U.S. Patent No. 5,976,991) (all of record).

With respect to claim 1, Chern teaches a method of forming sidewall spacers adjacent opposing vertical sides of a gate electrode substantially as claimed including:

- forming at least one gate electrode (14) over a substrate (10);
- forming a first silicon oxide film (20) conformally over the substrate (10) and gate electrode (14) from a combination of gases and oxygen at a temperature;
- forming a silicon nitride film (22) conformally over the first silicon oxide film (20) from a combination of gases, at a temperature; and
- forming a second silicon oxide film (24) over the silicon nitride film (22) from a combination of gases and oxygen. (See Fig. 4).

Thus, Chern is shown to teach all the features of the claim with the exception of using a specific precursor silane, temperature and pressure for the formation of the oxide and nitride layers. Note that, the claimed pressure and the first temperature being less than the second temperature do not appear to be critical.

However, Laxman teaches using an alternative silane precursor such as bis-(tertiarybutylamino)silane (a.k.a BTBAS) and oxygen to form silicon oxide at 550-625 °C and a combination of BTBAS and ammonia to form silicon nitride layer at 600 °C at an pressure of approximately 20 mTorr to 1 atmosphere.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the first silicon oxide (20), silicon nitride (22) and second silicon oxide (24) of Chern using a precursor silane including BTBAS at temperatures and pressure as taught by

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Laxman because BTBAS does not contain direct Si-C bonds thus, the deposited films have very low carbon content. (See col. 5, lines 29-31).

Regarding the claimed pressure, the disclosed pressure of Laxman includes “approximately 20 mTorr” this pressure is considered to be closed to the claimed value.

Regarding the first temperature being less than the second temperature, Laxman clearly teaches: the deposition temperatures of silicon oxide is in the range of 550-625 °C and of silicon nitride layer at 600 °C, although the first temperature (550-625 °C) overlaps the second temperature (600 °C), however, there is no direct evidence either in the specification or the claim itself showing that any unexpected results had occurred. Thus, the teaching of Laxman meet the limitations of the claim.

Note that, the 600 °C of Laxman can be seen as less than and more than 600 °C.

Further, Laxman teaches: silicon oxide, silicon nitride or silicon oxynitride can be formed using BTBAS at a temperature range 500 to 800 °C and pressure range 20 mTorr to 1 atmosphere. The claimed temperature and pressure are within Laxman’s teaching, thus, obvious.

Also note that, the claimed pressure and the first temperature being less than the second temperature do not appear to be critical. The specification contains no disclosure of either the critical nature of the claimed “*the first temperature being less than the second temperature*” of any unexpected results arising therefrom. Where patentability is aid to based upon particular chosen dimension or upon another variable recited in a claim, the Applicant must show that the

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chosen dimension are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

With respect to claim 2, forming the silicon oxide film of Chern in view of Laxman comprises providing one or more wafers in a furnace at first temperature, and flowing BTBAS and oxygen into the furnace.

With respect to claim 3, forming the silicon nitride and the silicon oxide films of Chern in view of Laxman comprises keeping the one ore more wafers in the furnace.

With respect to claim 4, forming the silicon nitride film of Chern in view of Laxman comprises maintaining the one or more wafers in the furnace at a second temperature, and flowing BTBAS and NH₃ into the furnace.

With respect to claim 5, forming the second silicon oxide film of Chern in view of Laxman comprises maintaining the one or more wafers in the furnace at the first temperature, and flowing BTBAS and oxygen into the furnace.

With respect to claims 7 and 9, Official Notice is taken, that purging the furnace prior to form another different film appears to be within the ability of one having ordinary skill in the art to prevent cross-contamination.

With respect to claims 8 and 10, Official Notice is taken, that how purging preformed is within the ability of one having ordinary skill in the art including shutdown all reactant gases follow by introducing inert gas then introducing the new reactant gas.

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With respect to claim 11, Chern teaches a method of forming sidewall spacers adjacent opposing vertical sides of a gate electrode substantially as claimed including:

forming at least one gate electrode (14) over a gate dielectric layer (12B), the gate dielectric layer (12B) disposed on a substrate (10);

depositing a first silicon oxide film (20) conformally over the substrate (10) and gate electrode (14) from a combination of gases and oxygen at a temperature;

depositing a silicon nitride film (22) conformally over the first silicon oxide film (20) from a combination of gases, at a temperature;

depositing a second silicon oxide film (24) over the silicon nitride film (22) from a combination of gases and oxygen; and

forming a first sidewalls spacer. (See Figs. 2-5).

With respect to the combination of gases precursor, temperature and pressure to form silicon oxide and nitride, similar reasoning as that of claim 1 is also applied here.

With respect to claims 12 and 13, all films of Chern in view of Laxman are deposited in-situ in a first furnace.

With respect to claim 14, the furnace of Chern in view of Laxman comprises a vertically oriented furnace and the flow of the reactant gases into the furnace from the bottom are well known.

With respect to claim 16, forming of the first sidewall spacer of Chern in view of Laxman comprises anisotropically etching the second silicon oxide film (24), the silicon nitride film (22) and the first silicon oxide film (20).

With respect to claim 17, the process of Chern in view of Laxman further includes removing the second oxide film (24) to form L-shaped spacers. (See Fig. 6).

4. Claims 15, 18 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chern '223 and Laxman '991 as applied to claims 11 and 17 above, and further in view of Miles (U.S. Patent No. 6,235,597) (of record).

With respect to claims 15 and 18, Chern and Laxman teach all the features of the claim with the exception of explicitly disclosing doping of the substrate to form source/drain regions which are the required elements of a MOS.

However, Miles teaches ion implantation is used to form a deep source/drain region in the substrate adjacent at least two opposing sides of the gate electrode. (See Fig. 3).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form source/drain regions adjacent to the gate of Chern as taught by Miles to reduce source/drain depth adjacent to the gate.

With respect to claim 19, the implanting dopant of Miles includes a partial passage of ions beam through a portion of the L-shaped spacers.

Response to Arguments

5. Applicant's arguments filed February 27, 2004 have been fully considered but they are not persuasive.

With respect to claims 1 and 11, Applicants argue that the combination of Chern and Laxman would be impermissible hindsight.

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

Applicants also state that there is no motivation to combine.

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, by using BTBAS to form oxide-nitride-oxide layers, one having ordinary skill in the art would have formed layers having very low carbon content (see Laxman col. 5, lines 29-31)

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which are sometime detrimental to semiconductor device. Thus, **there is motivation to combine** which is provided by the reference. (emphasis added).

Applicants further add: in fact, there is no disclosure in Laxman of forming sidewall spacers.

Note that, to form sidewall spacers, layers of material should be deposited. Clearly, Laxman teaches of forming those layers in a single reactor.

Applicants admitted that Chern and Laxman can be combined but would still not include all the limitations of claims 1 or 11, particularly, the second temperature range of 580 °C to less than 600 °C and the second pressure of 65 Pascal.

However, Laxman clearly teaches and recognized by the Applicants: “the temperature and pressure were maintained at 600 °C (with working temperature of 500 to 800 °C) and 500 mTorr (66.66 Pascal) (with working pressure of 20 mTorr to 1 atmosphere). Both temperature and pressure are proximate the claimed range, thus, obvious.

Furthermore, Applicants fail to provide any evidence that the temperature and pressure of Laxman do not produce the layers as claimed.

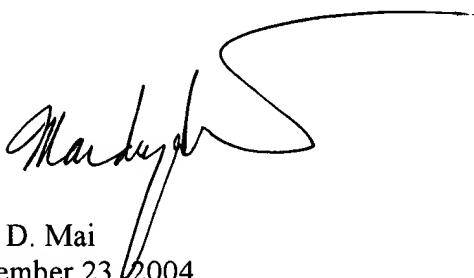
Regarding the reference to Miles, In response to applicant's argument that the temperature range disclosed in Miles is well above the temperature range of claim 11, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Conclusion

-Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (571) 272-1710. The examiner can normally be reached on 9:00AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'Anh D. Mai', with a long, sweeping horizontal line extending to the right.

Anh D. Mai
December 23, 2004